Original Article

Effects of mattress firmness and usage duration on low back pain: a hospital-based study from Lahore

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Abstract

Low back pain (LBP) is a prevalent global health issue that causes significant discomfort and disability. Previous research highlights the crucial role of mattress quality, particularly firmness and usage duration, in LBP management. This study aimed to examine sociodemographic and mattress usage characteristics, assessing LBP severity, comparing pain across different mattress firmness levels, and analyzing the correlation between mattress usage duration and LBP severity. This exploratory study was conducted at Hussain Memorial Hospital, Lahore, over two months in 2023. Using the purposive sampling method, this study recruited 130 male and female patients, aged 18 to 60 years, diagnosed with mechanical back pain through a positive Kemp test and who have been using the same mattress for over a year. The data were collected through face-to-face interviews using a questionnaire that incorporated the Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Index (MODI). Analysis was performed using SPSS 25.00, with significance set at p-value ≤ 0.05. Most of the patients reported moderate disability (78.46%) and preferred medium mattress firmness (29.23%), with an average mattress usage of 7.18 ± 3.49 years. Kruskal–Wallis tests revealed significant differences in LBP severity across mattress firmness levels ($p < 0.001$), with medium firmness associated with less pain. A positive correlation was found between mattress use duration and LBP severity, with r = 0.250 ($p = 0.004$). This study established a link between mattress firmness and LBP severity, with medium firmness potentially offering optimal relief. Additionally, a correlation exists between extended mattress usage and heightened LBP symptoms, suggesting that the age of a mattress may aggravate LBP. These insights highlight the importance of selecting a mattress by carefully considering both its firmness and usage duration as key factors in effective LBP management.

Keywords

1. Introduction

Low back pain (LBP) affects millions of people across all age groups globally, posing a significant health challenge often associated with substantial discomfort, disability, and economic costs [1]. Nearly 619 million individuals are affected by LBP worldwide, making it a leading cause of disability, with projections that it will surpass 843 million cases by 2050 [2]. LBP affects the lumbar region, which is essential for musculoskeletal function, presenting either a dull ache or sharp pain that may radiate, especially to the legs [3]. It causes stiffness, muscle tension, and mobility issues, substantially interrupting routine activities [2]. Additionally, LBP contributes to sleep disturbances, mood deterioration, increased distress, and an overall diminished quality of life [4]. The origins of

LBP are varied and include mechanical factors associated with spinal structures and non-mechanical causes such as systemic diseases [5].

LBP is mainly nonspecific, accounting for approximately 90% of cases and indicating that the pain does not stem from a specific disease, pathology, or tissue damage [6]. The treatment approach depends on whether the pain is classified as nonspecific or specific [2], with prolonged LBP often resulting in functional limitations [7]. Risk factors for nonspecific LBP include sedentary lifestyles, smoking, obesity, and high physical stress at work [8,9], emphasizing the role of lifestyle modifications in management strategies.

Studies have shown a significant association between mattress quality and LBP, mainly focusing on the level of firmness and the duration of use of the mattress [10,11]. Firmness and usage duration are found to critically affect spinal alignment, pressure distribution, and sleep quality [10,12], highlighting the necessity for a focused investigation into how these specific mattress characteristics contribute to LBP management. This understanding underscores the importance of selecting a mattress with suitable firmness and timely replacement to alleviate LBP [13], reinforcing the critical role of restorative sleep in enhancing the well-being of those with LBP [14].

In this context, our study aims to assess these links empirically. The impact of LBP on individual health and healthcare systems suggests the potential role of modifiable factors, like mattress selection, in managing pain [15]. This research aims to outline how mattress firmness and usage duration affect LBP mitigation, with the goal of providing insights that enable individuals suffering from LBP to make informed choices for improved health outcomes and sleep quality. The study's objectives include examining sociodemographic and mattress usage characteristics, assessing LBP severity, comparing pain across different mattress firmness levels, and analyzing the correlation between mattress usage duration and LBP severity. Our thorough analysis is designed to improve the broader discourse on nonpharmacological interventions for LBP, aiming to influence paradigms in both prevention and management.

2. Materials and methods

2.1. Study design, duration and ethics aproval

This exploratory study was conducted over two months between September and October 2023. Ethical approval was granted by the Ethics Review Committee (ERC) of Hussain College of Health Sciences, Lahore, Pakistan (No. HCHS/2023/ERC/40).

2.2. Study setting

The study was carried out at Hussain Memorial Hospital, a 50-bed private facility approved by the Punjab Healthcare Commission and affiliated with Hussain College of Health Sciences. Located in Lahore's urban core, the hospital serves diverse patient populations from various socioeconomic backgrounds.

2.3. Sampling technique and sample size

The nonprobability purposive sampling method was employed to recruit patients from the outpatient department of the hospital during the study period. All patients who met the inclusion and exclusion criteria were included in the study. The sample size was calculated to be 114 at a 95% confidence level, with a significance level set at 5% and a power of the test at 90%, based on a test value proportion of 60.78% and an anticipated population proportion of 75.00%, using the WHO calculator (version 2.0.21) [16]. To enhance the study's strength and account for potential dropouts, the sample size was subsequently increased to 136.

2.4. Study participants

Patients who presented with complaints of LBP or who were undergoing follow-up treatment for existing LBP in the outpatient department (OPD) of the targeted hospital were enrolled in this study.

2.5. Selection criteria

The study recruited male and female patients aged 18 to 60 years who were diagnosed with mechanical back pain, confirmed via a positive Kemp test, and who had been consistently using the same mattress for a minimum of one year. The exclusion criteria included patients who did not provide written informed consent, had previously undergone spinal surgery, or who were affected by systemic illnesses or metastatic diseases, pregnant females, individuals currently on any medications, obese individuals, patients previously diagnosed with arthritis, and those taking painkillers regularly or intermittently to manage pain.

2.6. Data collection tool and procedure

The data were collected via a questionnaire derived from an extensive review of the literature using validated scales such as the Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Index (MODI) [10,17,18,19]. The MODI for assessing LBP demonstrates robust reliability, with our study reporting Cronbach's alpha of $\alpha = 0.940$, significantly supporting the previously established reliability ($\alpha = 0.754$) [20].

The MODI scores, derived from ten items rated on a 0 to 5 scale, were aggregated and then normalized to a 100-point scale to accurately represent the percentage of disability severity. The normalized scores were classified into five distinct categories of disability severity: minimal (0 – 20%), moderate (21 – 40%), severe (41 – 60%), severe disability requiring intensive management (61 – 80%), and bedbound (81 – 100%).

The NPRS scores for current pain intensity, least pain intensity, worst pain intensity, and average pain intensity over the past 24 hours were determined based on participants' self-reported pain levels. The scores were categorized into four levels: no pain (score of 0), mild pain (scores 1 – 3), moderate pain (scores 4 – 6), and severe pain (scores 7 – 10).

In addition to validated scales, mattress firmness was assessed through self-reported measures, asking participants to categorize their mattress based on the firmness level at the time of purchase.

Face-to-face interviews were conducted to collect the data using a questionnaire. A counter shielded by screens was designated for conducting the interviews, which, on average, lasted between 5 and 10 minutes for each interview.

2.7. Statistical analysis

Data analysis was conducted using SPSS version 25.00. Descriptive statistics, including frequencies, percentages, means, and standard deviations, provided an overview of the sample characteristics. The Kruskal–Wallis H test, supplemented by post hoc tests with Bonferroni correction and mean rank scores from the Mann–Whitney U test, was used to examine the differences between mattress firmness and pain levels. Additionally, Spearman's rank correlation was used to assess the association between mattress duration and LBP severity. The results were considered significant at $p \le 0.05$.

3. Results

During the study period, 136 patients met the inclusion and exclusion criteria and were initially included in the study; however, after 6 participants dropped out, the final sample consisted of 130 patients.

Table 1. Sociodemographic and mattress usage characteristics of the study participants (n = 130).

Sociodemographics and Mattress Usage Characteristics		Frequency (%)	Mean ± SD
Gender	Female	100 (62.86)	-
	Male	30 (37.14)	-
Age (in years)		-	35.17 ± 8.11
Education (in years)		-	12.74 ± 4.55
Monthly household income (in PKR)		-	87,507.00 ± 186,570.86
Marital status	Married	112 (86.15)	-
	Single	18 (13.85)	-
Locality of patient	Rural	17 (13.08)	-
	Urban	113 (86.92)	-
Occupation	Employed	62 (47.69)	-
	Self-employed	30 (23.08)	-
	Student	8 (6.15)	-
	Unemployed	8 (6.15)	-
	Housewife	22 (16.92)	-
Brand of mattress	Diamond	28 (21.54)	-
	Master	36 (27.69)	-
	Dura	2 (1.54)	-
	Molty	62 (47.69)	-
	Fivestar	2 (1.54)	-
Type of mattress	Innerspring	36 (27.69)	-
	Hybrid	18 (13.85)	-
	Memory foam	30 (23.08)	-
	Gel-infused foam	2 (1.54)	-
	Polyfoam	18 (13.85)	-
	Latex	24 (18.46)	-
	Waterbed	2 (1.54)	-
Firmness level of the mattress	Soft	24 (18.46)	-
	Medium soft	20 (15.38)	-
	Medium	38 (29.23)	-
	Medium firm	30 (23.08)	-
	Firm	18 (13.85)	-
Duration of mattress usage (in years)		-	7.18 ± 3.49
Sleep (in hours)		-	6.95 ± 1.50
Sleeping position	Supine	18 (13.85)	-
	Prone	14 (10.77)	-
	Side-lying	98 (75.38)	-
Maintain the same position throughout sleep	Yes	54 (41.54)	-
	No	76 (58.46)	-
Nature of pain	Constant	6 (4.62)	-
	Intermittent	124 (95.38)	-
Sleep disturbance	Yes	88 (67.69)	-
	No	42 (32.31)	-
Duration of low back pain (in years)		-	2.72 ± 2.24

Table 1 shows the sociodemographic and mattress usage profiles of the study participants. Most of the participants were females,   accounting for 62.86%, compared to their male counterparts at 37.14%, with an average age of 35.17 ± 8.11 years. The average education level was 12.74 years, and the mean monthly household income was PKR 87,507. The data showed that the sample had a predominance of married individuals (86.15%) residing in urban areas (86.92%). Molty was the most commonly reported mattress brand (47.69%), with memory foam being the preferred type (23.08%). A significant proportion of participants preferred medium firmness (29.23%), and the average duration of mattress usage was 7.18 ± 3.49 years. The most common sleeping position was side-lying (75.38%), and a majority reported intermittent pain (95.38%) and experienced sleep disturbances (67.69%). The average duration of LBP among participants was 2.72 ± 2.24 years.

Table 2 shows that the majority of patients (78.46%) were classified with moderate disability according to MODI criteria, while severe disability was observed in 6 participants (4.62%), and no patients were categorized as bedbound. In terms of NPRS-measured pain intensity, 47.69% of participants reported moderate, and 52.31% reported severe current pain intensity. The least pain intensity was mostly mild (63.08%). A significant portion, 83.07%, experienced their worst pain intensity as severe. The average pain intensity over the last 24 hours was severe for 49.23% and moderate for 43.08% of participants, reflecting a consistent experience of pain within the group.

Table 2. Low back pain severity measured by the MODI and the NPRS (n = 130).

Low Back Pain Severity		Frequency (%)
Modified Oswestry Disability Index		
Minimal disability		18 (13.85)
Moderate disability		102 (78.46)
Severe disability		6 (4.62)
Severe Disability Requiring Intensive Management		4 (3.08)
Bedbound		0 (0.00)
Numerical Pain Rating Scale		
Current pain intensity	No Pain	0 (0.00)
	Mild Pain	0 (0.00)
	Moderate Pain	62 (47.69)
	Severe Pain	68 (52.31)
Least pain intensity	No Pain	0 (0.00)
	Mild Pain	82 (63.08)
	Moderate Pain	46 (35.38)
	Severe Pain	2 (1.54)
Worst pain intensity	No Pain	0 (0.00)
	Mild Pain	0 (0.00)
	Moderate Pain	22 (16.92)
	Severe Pain	108 (83.07)
Average pain intensity over the past 24 hours	No Pain	0 (0.00)
	Mild Pain	10 (7.69)
	Moderate Pain	56 (43.08)
	Severe Pain	64 (49.23)

The Kruskal–Wallis H test demonstrated a significant variation in low back pain severity across different mattress firmness levels ($p < 0.001$), with medium firmness associated with lower pain severity (Table 3). Post hoc analyses revealed significant differ-

ences between medium and both soft and firm mattresses, indicating that medium firmness might offer an optimal balance for mitigating LBP severity.

Table 3. Comparison of low back pain severity measured by the MODI across different mattress firmness levels (n = 130).

Variable	N	Mean Rank	U value	*p* Value **
Firmness level of the mattress	130	-	-	< 0.001 **
Post hoc tests				
Medium	38	23.64	2.974	0.029 **
Medium soft	20	40.63		
Medium	38	19.50	7.694	< 0.001 **
Soft	24	50.50		
Medium	38	19.51	-7.149	< 0.001 **
Firm	18	47.47		
Soft	24	42.48	5.236	< 0.001 **
Medium firm	30	15.52		
Medium firm	30	15.65	-4.942	< 0.001 **
Firm	18	39.25		
Medium soft	20	13.00	3.912	0.001 **
Soft	24	30.42		
Medium soft	20	12.38	-3.768	0.002 **
Firm	18	27.42		

* The severity of low back pain according to the mattress firmness was analyzed using the Kruskal–Wallis H test, which yielded a statistic of 87.091 with 4 degrees of freedom. ** A *p* value less than 0.05 was considered to indicate statistical significance. Post hoc pairwise comparisons were adjusted for multiple tests using the Bonferroni correction.

The correlation analysis between mattress usage duration and LBP severity, as measured by the MODI, yielded a Spearman's rank correlation coefficient of 0.250, with a significance level of $p = 0.004$ (significant at the 0.01 level, 2-tailed), indicating an association between prolonged mattress use and increased low back pain severity.

4. Discussion

Our study explored the relationships among mattress firmness, usage duration, and LBP, providing valuable insights into how sleep surface characteristics influence LBP severity. The demographic and mattress usage data of patients revealed considerable variations in personal and lifestyle factors, with a significant portion reporting moderate disability due to LBP. Our findings established an association between mattress firmness and LBP severity, indicating that medium firmness may offer optimal pain relief. Moreover, the results revealed a significant correlation between prolonged mattress usage and a surge in LBP symptoms, implying that older mattresses might worsen LBP outcomes. These findings underscore the need for individuals to make their mattress choices, considering both firmness and usage duration, in the broader context of LBP management and mitigation.

Our findings, which imply that medium-firmness mattresses are likely to benefit users in pain mitigation, are corroborated by a meta-analysis that classified mattresses in line with the European Committee for Standardization Standards. One study reported that a medium-firm mattress improves sleep and plays an influential role in pain alleviation [10]. Likewise, a study focusing on athletes indicated that mattress firmness significantly impacts LBP alleviation [21]. Consistent with these findings, another study from Bangladesh that examined individual and occupational factors related to LBP revealed

that individuals using soft mattresses reported more LBP instances than those using firmer mattresses [22]. A Pakistani study reported the same results among students, which highlighted that individuals sleeping on soft mattresses have a greater prevalence (60.78%) of LBP than individuals sleeping on firm mattresses (37.64%) [16]. However, these findings cannot be generalized, as individual needs can significantly influence the optimal mattress choice for LBP management [23]. Moreover, several studies have highlighted the significance of pillow care and mattress firmness combined with body posture, sleep comfort, and LBP development [12,24]. This aspect, however, represents a limitation of our study, as it did not consider pillow use—an essential factor for future research to explore.

The human body exerts pressure on the mattress when it is laid onto one; the same has been studied among infants, and it was observed that most of the pressure is observed in the spinal region, and there is also a correlation between the pressure and the mattress firmness [25]. Scientific studies have shown that the nature and type of mattress influence the distribution of pressure in the body and impact pain and quality of sleep [26]. Furthermore, studies have reported changes in the spine upon MRI, mainly because of the nature and type of mattress used. These changes are also among the major causes of LBP observed in healthy adults [27].

Our study revealed that LBP is associated with the duration of mattress use, which is in line with the findings of a Malaysian study conducted among young students. This study highlighted that mattress use duration significantly impacts LBP among young adults [28]. This finding is further supported by another Malaysian study identifying a poor-quality mattress as a crucial factor in LBP incidence [29]. A study conducted in Pakistan confirmed our research findings, emphasizing that individuals who have used a mattress for more than three years are more prone to experience LBP [12].

The strengths of this study are markedly increased by the selection of a focused participant cohort, facilitating an in-depth analysis of the relationships among mattress firmness, usage duration, and LBP severity. Furthermore, a major advantage of this research is its delivery of localized scientific evidence, which provides crucial insights with substantial implications for the targeted population. However, the study's scope was limited by not addressing various risk factors that could affect LBP, including mechanical labor and lifestyle choices. Additionally, several potential confounding factors, such as age, gender, nature of work, and sharing of the same mattresses, which could have influenced the results, were not considered in the data collection and analysis process. Being hospital-based also introduces a limitation in generalizing the findings to a broader population. The study's results lay a robust groundwork for future research through the application of rigorous statistical analysis and the inclusion of previously overlooked risk factors, thereby broadening the scope of LBP management and prevention strategies.

5. Conclusions

Our study revealed an association between mattress firmness and LBP severity, with medium mattress firmness potentially providing optimal relief for LBP sufferers. Moreover, prolonged mattress usage is correlated with increased LBP symptoms, indicating that mattress age may worsen LBP. These findings emphasize the necessity of choosing a mattress considering both its firmness and age as crucial elements of effective LBP management strategies.

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